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GB 2259205 A GB 2134734 A US 5007105 A

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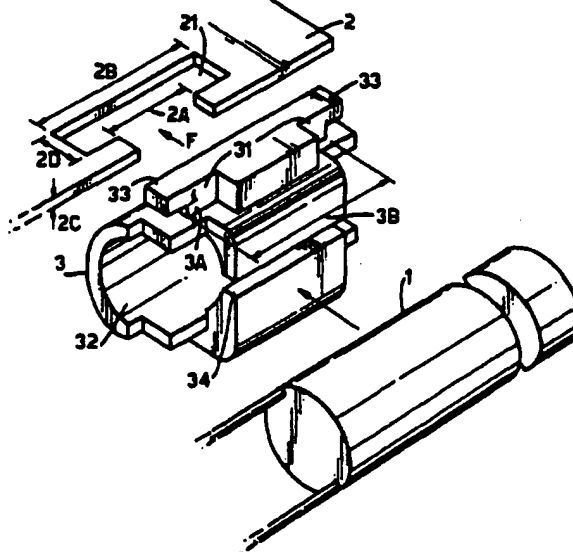
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(54) Vibration-generating-motor mounting structure

(57) A mounting structure of the vibration-generating-motor comprises a vibration-generating-motor and a holder for holding the vibration-generating-motor. A holding section of the holder contacts faced inner surfaces of a case and is held by the inner surfaces. Vibrations of the vibration-generating-motor are directly conveyed to the case through the holding section. For assembling, the holder holding the motor passes through a circuit board and is fixed by a hole formed on the circuit board. Then, the both ends of the holder are brought into contact with faced inner surfaces of the case so that the holder is held by the inner surfaces. The above structure enables vibrations of a vibration-generating-motor to be efficiently conveyed to the surface of the case and reduces undesirable sounds due to resonance of a circuit board.

Fig.1.

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Fig.1.

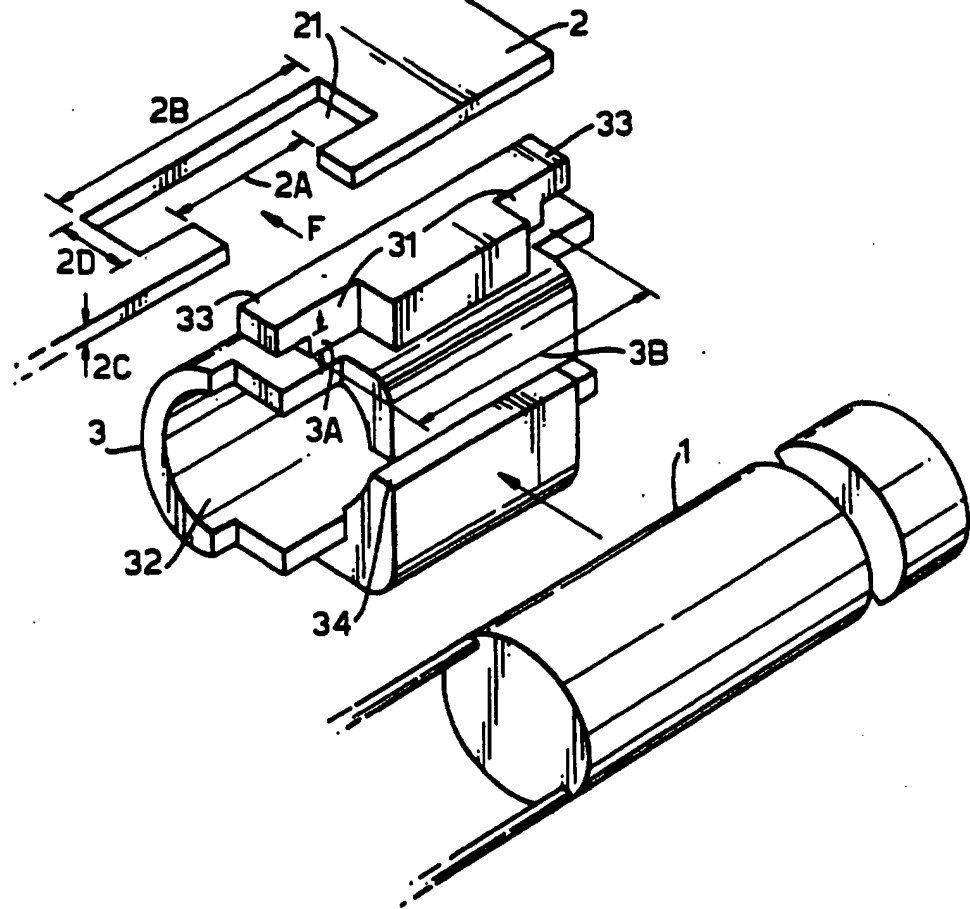
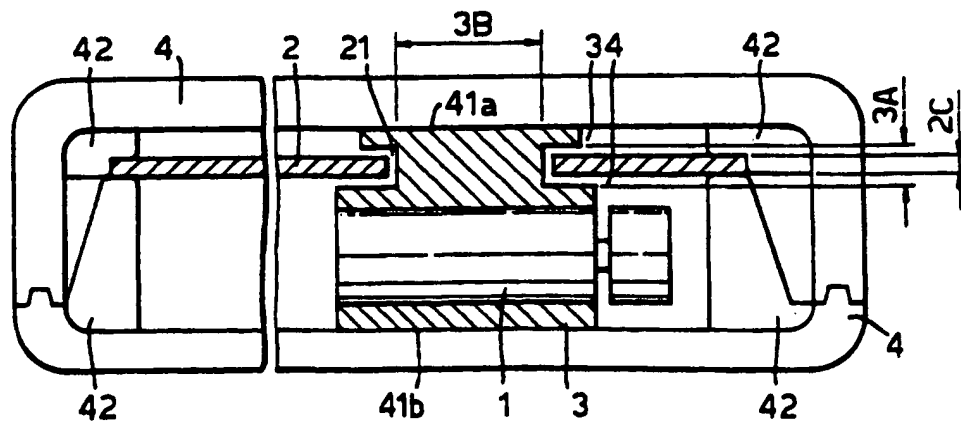


Fig.2.



VIBRATION-GENERATING-MOTOR MOUNTING STRUCTURE AND
ITS MOUNTING METHOD

Background of the Invention

The present invention relates to a vibration generating motor used for portable units, particularly to a vibration-generating-motor (hereinafter referred to as "vibrating
5 motor") mounting structure and its mounting method.

In the case of a machine, apparatus, or device, generation or reception of a signal has been notified to a user or the like by means of blinking of light by a lamp or signal sounds generated by a buzzer or the like.
10 However, some compact apparatuses or devices are provided with a system for notifying a user of generation or reception of a signal through vibrations. They include a clock for an aurally handicapped person, and a recent portable telephone and selective calling receiver.

15 For a selective calling receiver, a system for notifying a user of reception of a signal by sounds of a buzzer or speaker has widely been used. At a specific place, however, it may be preferable to generate vibrations of the receiver. Therefore, some models are provided with
20 a system for notifying a user of reception of a signal through vibrations instead of selective ringing tones by assuming the above case.

The structure disclosed in the official gazette of Japanese Utility Model Laid-Open No. 162747/1989 (document 1) is known as a vibration generating section used for this type of the selective calling receiver. The vibration
5 generating section disclosed in the document 1 uses a vibrating motor as a vibration source. In the case of the vibrating motor, the rotating shaft of a DC motor is provided with a weight whose center of gravity is deviated from the rotating shaft. The vibrating motor is set on a
10 circuit board and whose outer periphery is held by a holder and the holder is fixed to the circuit board. In the case of this structure, however, vibrations generated by the vibrating motor are conveyed to the surface of a receiver case through the circuit board. Therefore, the structure
15 has the problems that vibrations cannot efficiently be conveyed and undesirable sounds are produced due to resonance of the circuit board.

Summary of the Invention

It is an object of at least the preferred embodiments of the present invention to provide a vibrating motor mounting structure in which vibrations of a vibrating motor are efficiently conveyed to the surface of a case.

20 It is another such object to provide a vibrating motor mounting structure for reducing undesirable sounds from occurring due to resonance of a circuit board.

It is still another such object to provide a method of efficiently assembling the vibrating motor mounting structure and a selective calling receiver.

5 The present invention provides a vibration-generating-motor (as herein defined) mounting structure comprising a vibration-generating-motor and a holder for holding the motor, wherein the holder is directly held by (preferably faced) inner surfaces of a case, or is integral therewith. Thereby, vibrations of the motor are directly conveyed to a case or the surface of a
10 selective calling receiver or other alerting device through the holder. By vibration-generating-motor we mean a rotary or oscillating motor which generates out of balance force sufficient to be felt by a user carrying the device in a pocket or otherwise on his/her person, preferably without the generation of significant noise.

15 In another aspect the invention provides a portable alerting device comprising a vibration-generating-motor, a case and a circuit board, the motor being mounted in the case independently of the circuit board so that vibrations are transmitted to the case without passing through the circuit board.

20 In a further aspect the invention provides a method of mounting a vibration-generating-motor comprising the steps of:

arranging a holder holding a motor so as to extend through a hole formed on a circuit board and holding the holder by inner surfaces of a case.

The vibrating motor mounting structure preferably is assembled

in accordance with the following procedure. First, a circuit board to be set into a case of a selective calling receiver is prepared in which a holder is previously inserted into and fixed to a hole formed on the circuit board. Then, the circuit board and the holder are arranged at a predetermined position on one inner surface of the case by adjusting the positions of them. Finally, the holder is brought into contact with the other faced inner surface of the case so as to be held. The mounting method of the present invention has advantages that it can easily be assembled and sounds generated by a circuit board can be reduced because the holder of the assembled structure does not directly contact the board or, even if it directly contacts the board, the contact area is small.

Brief Description of the Drawings

The above and other objects, features, and advantages of the present invention will become apparent from the following detailed description when taken with the
5 accompanying drawings in which:

Fig. 1 is a partial exploded perspective view showing an embodiment of the vibrating motor mounting structure of the present invention; and

Fig. 2 is a partial sectional view showing an
10 embodiment of the vibrating motor mounting structure of the present invention.

Detailed Description of the Preferred Embodiments

The present invention can be applied to various portable units. However, a case is described below in
15 which the present invention is applied to a selective calling receiver.

Fig. 1 shows a part of the vibrating motor mounting structure of the present invention. In Fig. 1, a vibrating motor 1 has a weight whose center of gravity is deviated
20 from the rotating shaft of a cylindrical DC motor on the shaft of the DC motor. The weight can be formed into a shape obtained by cutting off part of a disk. It is also possible to use a structure in which the rotating shaft of a motor is set to a position slightly deviated from the
25 center of a disk. Though dimensions of a vibrating motor

depend on the model, the vibrating motor of this embodiment has a diameter of 6 mm and a length of 15 mm.

A vibrating motor holder 3 comprises a motor holding section 32, a fixing section 31, and a tongue piece 33
5 contacting the inner surfaces of a case.

It is preferable that the motor holder 3 is made of an elastic damping material. Specifically, it is possible to use rubber, organic resin, or a macromolecular material for the motor holder 3. This embodiment uses silicon
10 rubber for the motor holder 3. This material is properly selected in accordance with a condition such as an output of a vibrating motor. A damping material is used because vibrations are not easily conveyed to a circuit board 2 even if the motor holder 3 contacts the circuit board 2.

15 The motor holding section 32 has a cylindrical inner surface suited to the outer shape of the cylindrical vibrating motor 1 in order to hold the motor 1. Moreover, the motor holding section 32 is provided with a slit 34 into which the motor 1 is inserted along the cylindrical
20 inner surface.

The fixing section 31 has a function for fixing the motor holder 3 to the fixing hole 21 formed on the circuit board 2. The length 3B of the fixing section 31 is larger than the length 2A of the opening of the fixing hole 21
25 and slightly smaller than the length 2B of the fixing hole 21. The width of the fixing section 31 is set so

as to be slightly smaller than the width 2D of the fixing hole 21 and the height 3A of the section 31 is set so as to be slightly larger than the thickness 2C of the circuit board 2. By pushing in the fixing section 31 from the direction F in Fig. 1 through the opening of the fixing hole 21, it is possible to insert the motor holder 3 into the fixing hole 21. Because of the above dimensions, the motor holder 3 is not easily removed from the opening after it is once inserted.

10 The tongue piece 33 has a function for fixing the motor holder 3 to the fixing hole 21 formed on the circuit board 2 the same as the fixing section 31 does and particularly, it prevents the motor holder 3 from vertically getting out of the fixing hole 21 formed on the circuit board 2. Moreover, the tongue piece 33 has functions for stably holding the motor holder 3 and effectively conveying vibrations of the motor 1 to the inner surface 41a of the case because it increases the area for the motor holder 3 to contact the inner surface 41a. At least either of the length of the longitudinal side of the tongue piece 33 and the length between both ends of the piece 33 is slightly larger than the corresponding side 2D or side 2B of the fixing hold 21. Therefore, the motor holder 3 whose fixing section 31 is fixed by the fixing hole 21 does not get out of the fixing hole 21.

Fig. 2 shows the vibrating motor set in a case 4. In this embodiment, the case 4 is made of polycarbonate. The circuit board 2 is fixed to a circuit board holding rib 42 in the case 4. The motor holder 3 contacts the inner surface 41a of the case 4 at the position of the fixing hole 21 of the circuit board 2 and it is held by the inner surface 41a by being pressed from the both sides. The height 3A of the fixing section 31 equals the sum of the thickness 2C of the circuit board 2 and predetermined gaps 34 at the both sides of the circuit board 2. As already described, the fixing section 31 also has a predetermined gap in the in-plane direction of the circuit board 2. In this case, the gap is less than one millimeter. In this structure, even if the motor holder 3 contacts the circuit board 2, it is possible to reduce the undesirable sounds generated due to resonance of the circuit board 2 because the contact area between the holder 3 and the board 2 is small and the motor holder 3 uses a damping material.

As described above, the motor holder 3 is not easily moved due to the pressure applied by inner surfaces 41a and 41b of the case 4. However, it is also possible to rough either or both of the tongue piece 33 of the holder 3 and the inner surface 41a of the case 4 with which the tongue piece 33 contacts in order to more securely fix the motor holder 3 in the case 4. Moreover, it is possible to rough

either or both of the motor holding section 32 and the inner surface 41b of the case 4. Furthermore, it is possible to apply an adhesive or an adhesive tape to the above portions instead of roughing them. Furthermore, it is possible to form a fixing protrusion adjacently to an inner surface of the case with which the tongue piece 33 or the motor holding section 32 contacts. The circuit board 2 uses a circuit board made of epoxy resin and copper as a preferable example. It is also possible to use a circuit board made of other material (e.g. ceramic) for the board 2.

It is not always necessary to set the motor holder 3 to the central portion in the case 4 but it is also possible to set the holder 3 to a position separate from a printed circuit board when there is an extra space in the case 4.

Before assembling parts in the case 4, the following are first prepared. The vibrating motor 1 is inserted into the holding section 32 through the slit 34 formed along the holding section 32. Unless the holding section 32 has the slit 34, it is also possible to insert the vibrating motor 1 through a circular hole of the holding section 32 equivalent to the cross section of the motor 1. Furthermore, it is possible to apply an adhesive or an adhesive tape to the inner surface of the holding section 32 and/or the outer surface of the motor 1 so that the holding section 32 more securely holds the motor 1.

Then, the motor holder 3 is inserted into the fixing hole 21 by pushing the fixing section 31 through the opening of the fixing hole 21 in the direction F in Fig. 1. When the fixing hole 21 is present not at the lateral of the circuit board 2 but at the central portion of it, the
5 the circuit board 2 but at the central portion of it, the motor holder 3 is constituted in the fixing hole 21 by previously dividing the motor holder 3 into a part including the motor holding section 32 and a part including the tongue piece 33 and then unifying the both parts into
10 one body from the top and bottom of the fixing hole 21.

Assembling in the case 4 is performed as shown below.. First, the circuit board 2 to which the motor holder 3 is fixed is set to a predetermined position of the printed-circuit-board holding rib 42 on the inner surface 41b of
15 one side plate of the case 4. Then, the motor holder 3 is preferably adjusted and set so as to keep a predetermined gap from the circuit board 2 and these components are covered with the other side plate of the case 4 to form the case and hold the motor holder 3 with both inner
20 surfaces 41a and 41b. According to the above structure, vibrations of the vibrating motor 1 are efficiently conveyed to the surface of the case 4 through the motor holder 3. In the case of this assembling method, because the fixing section 31 of the motor holder 3 is fixed to
25 the fixing hole 21, the motor holder 3 is automatically set to an almost desired position by setting the circuit

board 2 to a predetermined position in the case 4.
Therefore, it is possible to simplify the process for
setting the motor holder 3 in the frame independently
of the circuit board 2.

5 When the vibrating motor mounting structure of
the present invention is applied to a selective calling
receiver, a display using liquid crystal or a light
emitting diode or the like is set on a printed circuit
board in addition to an electrical circuit. Moreover,
10 a speaker and a buzzer are set on the board depending on
the model. Furthermore, a battery receptacle is set in
the case 4 and a battery is set in the battery receptacle.
Though it is preferable to use a resin such as polycarbonate
as the material of the case 4, it is also possible to use
15 a metallic frame having an antenna function for the case 4.
The case 4 has a length of approx. 5 cm, a width of approx.
7 cm, and a depth of approx. 1 to 2 cm.

In an alternative embodiment, the motor holder may be formed integrally with the case. For example the case may be moulded in two halves, with internal surfaces locally shaped so as to conform to the motor casing, which thereby is tightly held when the case is assembled and closed
5 eg by securing screws or suitable complementary resilient snap fit portions on the two halves of the case. The circuit board is separately mounted in the case so that it is spaced from the motor, either by being positioned to one side, or by having an aperture or cut-out of sufficient size so as to surround the motor with an adequate clearance. Thus in use, vibrations from the
10 motor pass directly to the case without passing through the circuit board.

The material of the case should be chosen so that the mechanical impedance of the case structure in the region of the motor holder is reasonably matched to the vibration frequency and effectively transmits the vibration energy to the outside of the case.

15 While the present invention has been described in connection with certain preferred embodiments, it is to be understood that the subject matter encompassed by the present invention is not limited to those specific embodiments. On the contrary, it is intended to include
20 all alternatives, modifications, and equivalents as can be included within the spirit and the scope of the following claims.

Each feature disclosed in this specification (which term includes the claims) and/or shown in the drawings may be incorporated in the invention
25 independently of other disclosed and/or illustrated features.

The appended abstract as filed herewith is included in the specification by reference.

What is claimed is:

1. A vibration-generating-motor (as herein defined) mounting structure comprising a vibration-generating-motor and a holder for holding the motor,
5 wherein the holder is directly held by inner surfaces of a case, or is integral therewith.
2. The structure according to Claim 1, wherein the holder passes through a hole formed in a circuit board set in the case.
3. The structure according to Claim 2, wherein part of the outer
10 periphery of the hole formed on the circuit board forms an opening at an edge of the circuit board.
4. The structure according to Claim 2, wherein the holder is provided with a holding section for holding the motor, a tongue piece contacting the inner surface of the case, and a fixing section passing through the hole
15 formed in the circuit board.
5. The structure according to Claim 4, wherein the holding section of the holder is provided with a cylindrical inner surface having an circular opening.
6. The structure according to Claim 1, wherein the holder is made of a vibration-damping material.
7. The structure according to Claim 6, wherein the damping material is
20 rubber, organic resin, or a macromolecular material.
8. A selective calling device comprising a structure according to any preceding claim.

9. A method of mounting a vibration-generating-motor comprising the steps of:

5 arranging a holder holding a motor so as to extend through on a hole formed on a circuit board and holding the holder by inner surfaces of a case.

10. A portable alerting device comprising a vibration-generating-motor, a case and a circuit board, the motor being mounted in the case independently of the circuit board so that vibrations are transmitted to the case without passing through the circuit board.

10 11. A device according to Claim 10 wherein the motor is mounted in a holder which is held by inner surfaces of the case or is formed integrally therewith.

12. A device according to Claim 10 or 11, being a selective calling receiver.

15 13. A vibration-generating-motor mounting structure or a method substantially as herein described with reference to the accompanying drawings.



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Claims searched: 1 to 13

Examiner: Colin Thompson
Date of search: 15 November 1995

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.N): F2S (SSF,SSG,SSJ,SSL); H3Q (QACX,QAL,QAX,QLX)

Int Cl (Ed.6): B06B 1/16; G08B 6/00; H02K 7/06

Other: Online databases: WPI, EDOC, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	GB 2259205 A (NEC Corp) See especially Fig 3	1,8,10,11, 12
X	GB 2134734 A (NEC Corp) See especially Fig 7	1,8,10,11, 12
X	US 5007105 A (Kudoh) See especially Figs 21 & 22	1,8,10,11, 12
X	US 4893351 A (McKee) See especially Col 5 lines 10-15	1,8,10,11, 12
X	US 4864276 A (Tribbey) See especially Col 3 lines 24-27	1,8,10,11, 12
X	US 4794392 A (Selinko) See especially Fig 1	1,8,10,11, 12

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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